JP 10-318733

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical equipment for mainly obtaining a confocal image for the object of three-dimension measurement.
[0002]
[Description of the Prior Art] The image obtained by a confocal image pick-up system, and a call and its confocal image pick-up system in the optical system which obtains an image according to confocal optical system will be called a confocal image, and the conventional technique is explained below. When a confocal image pick-up system performs three-dimension measurement, they are a general laser scanning mode as a confocal image pick-up system, and Nipkow. The two-dimensional array mold confocal image pick-up system which does not have a scanner like a disk scanning mode, but arranges a confocal pinhole to two-dimensional, and carries out simultaneous exposure of each pixel of a confocal image is suitable for because of the rapidity, and is indicated by JP,4-265918,A and JP,7-181023,A. Moreover, the same artificer as this invention applies as Japanese Patent Application No. 8-94682. Moreover, work: "Three-dimensional analysis by a microlens-array confocalarrangement" besides paper H.J.Tiziani, Applied Optics, Vol.33, No.4, and pp.567-572 (1994) have realized the two-dimensional array mold confocal image pick-up system by arranging a micro lens to two-dimensional rather than arranging a confocal pinhole to two-dimensional, and using as an objective lens. These conventional techniques are explained below.
[0003] The equipment (it considers as the conventional technique A below) by JP,4-265918,A is shown in drawing 12 . The light which came out of the light source 1 is irradiated as a parallel light with a collimate lens 4 at the pinhole array section 7. The pinhole array section 7 arranges many pinholes at the same flat surface here. The light which passed through each pinhole of the pinhole array section 7 is equivalent to it being considered that each is the point light source and the point light source being arranged. The light which passed through the pinhole is projected on Body A with the objective lens 8 which penetrated the half mirror 121 and consisted of lenses 8a and 8b and tele cent rucksack drawing 9 the back. The light reflected from Body A is condensed with an objective lens 8, and the quantity of light which passed through each pinhole by the detector array 123 to which the optical path was deflected with the half mirror 121, it reached on the detector pinhole array section 122 with each pinhole of the pinhole array section 7 and the pinhole by which location ****** was optically carried out to one to one in the same location at accuracy, and each detector was connected with each pinhole of the detector pinhole array section 122 by one to one is detected. The above configuration is equivalent to having arranged confocal optical system to juxtaposition exactly. In this official report, although the detector pinhole array section which is generally needed into a detector part is made unnecessary by using a CCD sensor with a low (the ratio of the optoelectric transducer to a pixel being small) numerical aperture, let the more general above-mentioned configuration be the conventional technique A.
[0004] Next, the equipment (it considers as the conventional technique B below) by JP,8-94682,A is explained using drawing 13 . The illumination light which came out from the

light source 1 serves as the point light source at a pinhole 2, turns into parallel light with a collimate lens 4, and is injected. The optical-path branching optical element 5 is a polarization beam splitter, and the illumination light turns into the linearly polarized light, and passes it. Incidence of the illumination light which passed the optical-path branching optical element 5 is carried out to the micro-lens array section 6, and it is condensed by the focus of each micro lens. The pinhole array section 7 is installed in the focal location of the micro-lens array section 6, and it has the form where each pinhole exists in the location of the focus of the illumination light condensed by each micro lens. Incidence of the illumination light which passed through the pinhole is carried out to an objective lens 8, it turns into the circular polarization of light with 1 / 4 phase-contrast plate 10 formed in the objective lens 8 interior, and projects the image of a pinhole on Body A. the both-sides tele cent to which an objective lens 8 has the tele cent rucksack drawing 9 and Lenses 8a and 8b in the interior -- it is a rucksack lens, and even if it moves Body A or optical system in the direction of an optical axis, scale-factor change occurs. Incidence of the reflected light from Body A is again carried out to an objective lens 8, and it turns into the linearly polarized light which intersects perpendicularly with the illumination light with 1 / 4 phase-contrast plate 10, and it is condensed and it reaches the pinhole array section 7 again. The reflected light which passed through the pinhole of the pinhole array section 7 serves as the parallel flux of light by the micro-lens array section 6, and is injected. Since the illumination light is a linearly polarized light light which intersects perpendicularly, the reflected light is deflected by the optical-path branching optical element 5 which is a polarization beam splitter, and carries out incidence to the image formation optical department 16. It is condensed so that image formation of the field of the micro-lens array section 6 may be carried out on the two-dimensional photoelectrical sensor 15 with the image formation lens 12 constituted by lens 12a and lens 12b, and the reflected light which carried out incidence to the image formation optical department 16 reaches on the two-dimensional photoelectrical sensor 15. On the two-dimensional photoelectrical sensor 15, a confocal image is obtained by this, photo electric translation is carried out by the two-dimensional photoelectrical sensor 15, and it is outputted as an electrical signal. The big difference from the conventional technique A is the point that the pinhole array section by the side of lighting and the pinhole array section by the side of a detector were not divided, but the one pinhole array section serves as both. The equipment currently indicated by JP,7-181023,A in this semantics is also contained in this conventional technique B.

[0005] Next, work: "Three-dimensionalanalysis by a microlens-array confocal arrangement" besides paper H.J.Tiziani, Applied Optics, Vol.33, No.4, and the equipment (it considers as the conventional technique C below) by pp.567-572 (1994) are explained using drawing 14 . The illumination light which came out of the light source 1 serves as the point light source by the pinhole 2, and turns into parallel light with a collimate lens 4. A half mirror 141 is passed after that and the micro-lens array 142 irradiates. Each micro lens of the micro-lens array 142 condenses the illumination light, and projects a spot on Body A. After being condensed by the same micro lens as the micro lens in which the spot was formed, and the reflected light from Body A turning into parallel light and deflecting it with a half mirror 141, it connects a spot on the pinhole 143 arranged in response to the image formation operation by lens 12a in the focal location of lens 12a. The reflected light which passed through the pinhole 143 turns into parallel light again by

lens 12b, and carries out incidence to the two-dimensional photoelectrical sensor 15. Lenses 12a and 12b and a pinhole 143 have achieved the duty which reproduces the intensity distribution for parallel Mitsunari on the two-dimensional photoelectrical sensor 15 as it is among the reflected lights outputted from the top face of the micro-lens array 142. A confocal pinhole's lighting and detector side is one, and does not become array-like like the conventional techniques A and B, but the objective lens of the difference from the conventional techniques A and B is the point which has become array-like instead.

[0006]

[Problem(s) to be Solved by the Invention] That it is common on these conventional techniques is the point of performing two-dimensional exposure in simultaneous juxtaposition. You may say that it is the point which forms many spots of two-dimensional array in a body in simultaneous juxtaposition. It can be said that the multi-beam is used to the laser scan using the single beam as compared with the case of the most general laser scan as a confocal image pick-up system. Below, such a description will be called multi-beam confocal.

[0007] Since a spot is formed in simultaneous juxtaposition, in a multi-beam confocal case, it poses a problem that the image formation flux of light to which other beams faded is mixed with the image formation by a certain beam. Although the effect of other beams natural in the case of a single beam cannot be considered, it cannot disregard effect of the adjoining beam especially in the case where it is a multi-beam. If it is bright and a focus separates when these effects were large and there is a focus, the confocal effectiveness of becoming dark will not be acquired. For this reason, in a multi-beam confocal case, the device which makes effect of an adjacent beam small is important. In order to make effect of an adjacent beam small, it is common to take the large ratio of the diameter of a spot and the distance between spots (it is called a spot pitch below). However, if this large ratio is taken and the number of beams is the same, in the case of the conventional techniques A and B, the magnitude of the pinhole array section will become remarkably large, the field angle of an objective lens becomes large and a fabrication of an objective lens will become very difficult. Though there is no trouble of an objective lens fabrication, a difference does not have the conventional technique C in the confocal effectiveness that the direction with little effect of the beam which adjoins as much as possible is higher being acquired.

[0008] Then, this invention aims at offering the two-dimensional array mold confocal optical system which can reduce the effect of the beam which adjoins each other, without enlarging the ratio of the diameter of a spot, and a spot pitch.

[0009]

[Means for Solving the Problem] Two-dimensional array mold confocal optical equipment constitutes so that it may have an illumination-light change means change the plane of polarization of the illumination light so that it may have the plane of polarization plane of polarization and the illumination light injected from the pinhole which adjoins the two-dimensional array mold confocal optical equipment which has the pinhole array section like the conventional techniques A and B for the object achievement cross at right angles mutually, and the selection light-analysis means which carry out selection transparency so that the plane of polarization may intersect perpendicularly mutually between the pinholes where the reflected light from a body adjoins each other.

[0010] The linearly polarized light means which makes the illumination light the linearly polarized light, and a liquid crystal cell with the transparent electrode array of the array corresponding to each pinhole of the pinhole array section constitute the above-mentioned illumination-light change means, and it constitutes a selection light analysis means with the liquid crystal cell of said illumination-light change means, a common liquid crystal cell, and the light analysis means that penetrates only the linearly polarized light of a certain direction.
[0011] Moreover, two-dimensional array mold confocal optical equipment constitutes so that it may have an illumination-light change means change the plane of polarization of the illumination light so that it may have the plane of polarization plane of polarization and the illumination light injected from an adjacent micro lens cross at right angles mutually in the two-dimensional array mold confocal optical equipment which made an objective lens like the conventional technique C the micro-lens array, and the selection light-analysis means which carries out selection transparency so that the plane of polarization may intersect perpendicularly mutually between the micro lenses which the reflected light from a body adjoins.
[0012] The linearly polarized light means which makes the illumination light the linearly polarized light, and a liquid crystal cell with the transparent electrode array of the array corresponding to each micro lens of a micro-lens array constitute the above-mentioned illumination-light change means, and it constitutes a selection light analysis means with the liquid crystal cell of said illumination-light change means, a common liquid crystal cell, and the light analysis means that penetrates only the linearly polarized light of a certain direction.
[0013] Or both an illumination-light change means and a selection light analysis means are the same polarizing plate arrays, and said polarizing plate array is constituted so that it may have the structure where an adjacent polarizing plate is a crossed Nicol mutually.
[0014] Or both an illumination-light change means and a selection light analysis means are the same phase contrast plate arrays, and said phase contrast plate array is constituted so that it may have the phase contrast from which 1/2 wave of adjacent phase contrast plate differs mutually.
[0015]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing. The first example of the gestalt of operation of this invention is shown in drawing 1 . The basic structure of the two-dimensional array mold confocal image pick-up system of this example is the same object as the conventional technique B. The overlapping explanation is avoided and only a different part is explained. Only the power sources 21 which impress an electrical potential difference to the liquid crystal cell 20 installed in the pinhole array section 7 bottom and a liquid crystal cell 20 differ. The optical-path branching optical element 5 is a polarization beam splitter, and a liquid crystal cell 20 and the optical-path branching optical element 5 as a linearly polarized light means work as an illumination-light change means to the illumination light, and it commits a liquid crystal cell 20 and the optical-path branching optical element 5 as a light analysis means as a selection light analysis means to the reflected light from a body.
[0016] First, the structure is explained in full detail about a liquid crystal cell 20, and the motion as a lighting change means and a selection light analysis means is explained after

that. The structure of a liquid crystal cell 20 is shown in drawing 2 . Drawing 2 (a) is a side elevation. A transparent electrode (ITO film) 201 is under the pinhole array section 7, and liquid crystal 204 is further enclosed between the transparent electrodes 202 of the lower transparent electrode substrate 203. The transparent electrode 201 serves as a hound's-tooth check-like configuration, as shown in drawing 2 (b), one pinhole of the pinhole array section 7 supports 1 ** of a grid, and the electrical potential difference is always impressed between a transparent electrode 201 and 202 according to the power source 21. A transparent electrode 202 is a common electrode without a pattern.

[0017] The liquid crystal molecules of liquid crystal 204 are a transparent electrode 201 and the torsion pneumatic liquid crystal (it considers as TN liquid crystal below) from which it became a distorted array 90 degrees among 202. Since the part without the pattern of transparent electrodes 201 and 202 does not require an electrical potential difference for a liquid crystal molecule, if the linearly polarized light light which polarized in the direction of a major axis of a liquid crystal molecule carries out incidence, output light will turn into the linearly polarized light in which plane of polarization carried out the rotatory polarization 90 degrees according to the rotatory-polarization effectiveness of a torsion array. Since torsion structure is canceled and the liquid crystal part by which the electrical potential difference is applied with transparent electrodes 201 and 202 on the other hand does not have torsion of a liquid crystal molecule inter-electrode, the rotatory polarization of it will not be carried out at all, but it will be passed in the state of polarization as it is.

[0018] The motion as a lighting change means by this liquid crystal cell 20 and the optical-path branching optical element 5 as a linearly polarized light means is described. The illumination light which turned into the linearly polarized light by the optical-path branching optical element 5 passes through the pinhole where it is condensed by each micro lens of the micro-lens array section 6, and the pinhole array section 7 corresponds, and it carries out incidence to a liquid crystal cell 20. The illumination light injected from a liquid crystal cell 20 is changed so that it may become the linearly polarized light light which has a transparent electrode within a liquid crystal cell 20 and from which it responds nothing and plane of polarization differs 90 degrees. Since the pattern of a transparent electrode 201 is a hound's-tooth check-like, it will have the plane of polarization plane of polarization and the illumination light injected from an adjacent pinhole cross at right angles mutually (however, a slanting next door presupposes that it is not regarded as a next door).

[0019] Next, the motion as a selection light analysis means by the liquid crystal cell 20 and the optical-path branching optical element 5 as a light analysis means is described. The illumination light which injected the liquid crystal cell 20 turns into the circular polarization of light with 1 / 4 phase-contrast plate 10, and the illumination light is in the condition that plane of polarization changed 90 degrees, after 180 phase jumps occurring and passing 1 / 4 phase-contrast plate 10 again as the reflected light, when reflecting by Body A. In the part which does not have the pattern of a transparent electrode 201 within a liquid crystal cell 20, the reflected light which carried out incidence to the liquid crystal cell 20 again passes through a pinhole in the state of polarization as it is, and plane of polarization carries out the rotatory polarization of it 90 degrees, and it passes through a pinhole in a place with a pattern. After being the plane of polarization which intersects perpendicularly and passing the micro-lens array section 6, it is deflected by the optical-

path branching optical element 5 at the time of the illumination light which turned into the linearly polarized light by the optical-path branching optical element 5 after passing through a pinhole, whichever it made it, and it reaches the two-dimensional photoelectrical sensor 15.
[0020] the beams which considering the light which it fades and carries out incidence to the next pinhole on the other hand the reflected light before carrying out incidence to a pinhole (accuracy liquid crystal cell 20) adjoins (refer to drawing 3) -- since it is in the polarization condition which intersects perpendicularly mutually, plane of polarization differs from the light which carried out incidence of the reflected light which it fades and carries out incidence from a next door to normal 90 degrees. Plane of polarization differs from the light which carried out incidence also of the plane of polarization when being injected to the optical-path branching optical element 5 to normal after all 90 degrees from the pinhole as for which the reflected light from which plane of polarization differs 90 degrees carried out incidence, the optical-path branching optical element 5 is penetrated, without the optical-path branching optical element 5 deviating, and the two-dimensional photoelectrical sensor 15 is not reached.
[0021] The reflected light of the next pinhole mixing and lowering the confocal effectiveness by the above motions, is lost. It is small if it compares with the effect of the next reflected light, although a slanting next door and the next light which faded from the next door again may mix, of course.
[0022] Although the conventional technique B was used as an example in this example, even if it is the conventional technique A, there is no big difference theoretically. Prepare the above-mentioned liquid crystal cell 20 and two sets of a power source 21, and it attaches in both the pinhole array section 7 by the side of lighting, and the detector pinhole array section 122 by the side of a detector. The polarizing plate which is a linearly polarized light means is prepared on the pinhole array section 7 by the side of lighting. What is necessary is just to set the polarizing plate which is a light analysis means by the polarizing plate of a linearly polarized light means, and arrangement of a parallel nicol between the detector pinhole array sections 122 between the detector pinhole array section 122 by the side of a detector, and the detector array 93, or by the side of a liquid crystal cell 20 and a detector.
[0023] Moreover, in order to make it the illumination light reflected on micro-lens array section 6 front face not go to the direction of the two-dimensional photoelectrical sensor 15 by this example, in it, the optical-path branching optical element 5 which is a polarization beam splitter, and a polarizing element like 1 / 4 phase-contrast plate 10 are used, but since it is also possible to remove by decreasing an echo of micro-lens array section 6 front face by coating etc., or leaning the micro-lens array section 6, it is unnecessary in a polarizing element in this case. In such a case, the desired object can be attained only by preparing a polarizing plate between a liquid crystal cell 20 and the pinhole array section 7, as shown in drawing 4 . At this time, the optical-path branching optical element 5 is good at a non-polarization beam splitter, and it is unnecessary in 1 / 4 phase-contrast plate 10. Also to the equipment by JP,7-181023,A, it does in this way and the same thing can be realized.
[0024] Neither the location of a liquid crystal cell 20 nor arrangement of a polarizing element necessarily needs to be as this example. For example, a liquid crystal cell 20 is the transparent electrode arrangement same on the micro-lens array section 6 as the

micro-lens array section 6, may insert liquid crystal into two transparent electrode substrates, and may arrange it with a liquid crystal cell independent mold. In addition, the arrangement considered that it is possible to acquire the same effectiveness is considered [that it is various and].

[0025] Moreover, although the liquid crystal in a liquid crystal cell 20 is TN liquid crystal Since what is necessary is just to become the light which has the plane of polarization which intersects perpendicularly mutually in the place which the electrical potential difference has required, and the place which it has not taken when the illumination light of the linearly polarized light passes liquid crystal Besides what used the optical activity of liquid crystal like TN liquid crystal, as 1/2 wave of phase contrast is given to an ordinary ray and an extraordinary ray using the electric-field control birefringence effectiveness, plane of polarization may be changed 90 degrees.

[0026] Moreover, although the pattern of a transparent electrode 201 is a hound's-tooth check-like, it is not necessary to be necessarily a hound's-tooth check-like that a beam deflection side should just intersect perpendicularly at adjacent pinholes. For example, since the plane of polarization of the beam which an one direction adjoins at least intersects perpendicularly even if it is a stripe-like, even if there is no effectiveness like a hound's-tooth check, a certain effectiveness is acquired. Moreover, also when the array of the micro-lens array section 6 is a hexagonal array, it is necessary to double a pattern configuration with it.

[0027] Next, the second example of the gestalt of operation of this invention is shown in drawing 5 . The basic structure of the two-dimensional array mold confocal image pick-up system of this example is the same object as the conventional technique C. In this case, although it explains since there is no pinhole array section and it is the same as that of the first example, as a fundamental principle, it is completely the same as the first example. As shown in drawing 5 , a liquid crystal cell (it may be a top) 20 is arranged under the micro-lens array 142. What is necessary is just to position so that 1 ** of the grid pattern of a transparent electrode 201 may correspond to one micro lens of the micro-lens array 142. A polarizing plate 51 is arranged above a liquid crystal cell 20 to serve both as a linearly polarized light means and a light analysis means. If it does in this way, the same effectiveness as the first example will be acquired. A power source 21 is also required with a natural thing.

[0028] Next, the third example of the gestalt of operation of this invention is shown in drawing 6 . The basic structure of the two-dimensional array mold confocal image pick-up system of this example is the same object as the conventional technique B. Different points from the first example are the point which the optical-path branching optical element 5 is a non-polarization beam splitter, and is the case where there is not 1 / 4 phase-contrast plate, and an echo of the front face of the micro-lens array section 6 can be disregarded, and a point that the polarizing plate array 61 is installed in the bottom of the pinhole array section 7 instead of being a liquid crystal cell 20.

[0029] The polarizing plate array 61 arranges the polarizing plate of the polarization direction of a crossed Nicol in the shape of a hound's-tooth check mutually, as shown in drawing 7 . It is arranged so that polarizing plates may correspond to each of this pinhole one by one. If the non-polarized illumination light (it has the 2-way polarization component which intersects perpendicularly at least) injects from the pinhole array section 7 and carries out incidence to this polarizing plate array 61, the illumination light

injected from the polarizing plate array 61 will turn into the linearly polarized light according to the direction of the polarizing plate of each of the polarizing plate arrays 61. The illumination light injected from the polarizing plate array 61 as a result will have the polarization direction where adjacent beams intersect perpendicularly mutually.
[0030] He is trying for the light in which the polarizing plate array 61 worked also as a selection light analysis means, and the next beam to reflect faded not to mix. That is, since the polarization directions differ, even if it has mixed, the next beam serves as a polarizing plate and a crossed Nicol, and can pass through a pinhole. Even if the two-dimensional array mold confocal image pick-up system of the base is the conventional technique A, this example is also the talk which prepares only two polarizing plate arrays 61, and is completely the same. [as well as the first example]
[0031] Next, the fourth example of the gestalt of operation of this invention is shown in drawing 8 . Although the basic structure of the two-dimensional array mold confocal image pick-up system of this example is the same object as the conventional technique C, the difference from the second example is the point that the polarizing plate array 61 is installed in the bottom of the micro-lens array 142 instead of the liquid crystal cell 20.
[0032] The polarizing plate array 61 is the same as the third example, and the reflected light mixes in the micro lens of the micro-lens array 142 which adjoins each other by the same principle as the third example.
[0033] Next, the fifth example of the gestalt of operation of this invention is shown in drawing 9 . The basic structure of the two-dimensional array mold confocal image pick-up system of this example is the same object as the conventional technique B. A different point from the first example is a point that the phase contrast plate array 91 is installed in the bottom of the pinhole array section 7 instead of the liquid crystal cell 20. Unlike the third example, the optical-path branching optical element 5 is a polarization beam splitter, and 1 / 4 phase-contrast plate is also installed.
[0034] The phase contrast plate array 91 arranges a hole (phase contrast 0), and 1 / 2 phase-contrast plate in the shape of a hound's-tooth check, as shown in drawing 10 . It is arranged so that each of this measure may correspond to each pinhole. If the light of the linearly polarized light which inclined 45 degrees to the direction of an optical axis of 1 / 2 phase-contrast plate in the phase contrast plate array 91 is used as illumination light, in the part of a hole, the polarization direction will not change according to phase contrast 0, but, as for the illumination light injected from the phase contrast plate array 91, the polarization direction will change 90 degrees with the illumination light in the parts of 1 / 2 phase-contrast plate. The illumination light injected from the phase contrast plate array 91 as a result will have the polarization direction where adjacent beams intersect perpendicularly mutually.
[0035] He is trying for the light in which the phase contrast plate array 91 worked also as a selection light analysis means, and the next beam to reflect faded not to mix. This principle is the same as the first example. It explains using drawing 9 . The beam from which the polarization direction differs 90 degrees is injected from the phase contrast plate array 91, become the circular polarization of light with 1 / 4 phase-contrast plate 10, Body A irradiates, and a jump of a phase occurs about 180 degrees in the reflex time in Body A. After passing 1 / 4 phase-contrast plate 10 again as the reflected light, the polarization direction differs from the time of the illumination light 90 degrees for every beam. When passing the phase contrast plate array 91, in the part of a hole, pass as it is,

and in the parts of 1 / 2 phase-contrast plate, the polarization direction is changed 90 degrees. The light which passed the part of a hole after all, and the light which passed 1 / 2 phase-contrast plate serve as the same polarization direction (it intersects perpendicularly with the illumination light), will be deflected by the optical-path branching optical element 5, and will reach the two-dimensional photoelectrical sensor 15. Since the deflection directions differ when the reflected light of the next beam carries out incidence to a pinhole, it is not deflected depending on the optical-path branching optical element 5, and the two-dimensional photoelectrical sensor 15 cannot be reached. Even if the two-dimensional array mold confocal image pick-up system of the base is the conventional technique A, this example is also the talk which prepares only two phase contrast plate arrays 91, and is completely the same. [as well as the first example]

[0036] Next, the sixth example of the gestalt of operation of this invention is shown in drawing 11 . Although the basic structure of the two-dimensional array mold confocal image pick-up system of this example is the same object as the conventional technique C, the difference from the second example is the point that the phase contrast plate array 91 is installed in the bottom of the micro-lens array 142 instead of the liquid crystal cell 20.

[0037] The phase contrast plate array 91 is the same as the fifth example, and the reflected light mixes in the micro lens of the micro-lens array 142 which adjoins each other by the same principle as the fifth example.

[0038] Although the phase contrast plate array of the fifth example of this invention and the sixth example is the array of the hole of phase contrast 0, and the phase contrast plate of 1/2 wave of phase contrast, since there should just be 1/2 wave of difference among two kinds of phase contrast plates, the same effectiveness can be acquired also in the combination of one wave of phase contrast plate, and 1/2 wave of phase contrast plate.

[0039]

[Effect of the Invention] As for the two-dimensional array mold confocal optical equipment of this invention, mixing of the light which faded from the next pinhole surely generated in multi-beam confocal can raise **** and the confocal effectiveness. Or a pinhole pitch can be made small if it is the same confocal effectiveness.

[Translation done.]